NAVIGATION SYSTEM FOR CONFOCAL LASER ENDOMICROSCOPY TO IMPROVE OPTICAL BIOPSY OF PERIPHERAL LESIONS IN THE LUNGS (NAVICAD)

[B. Projects financed under health & food safety and renewable energy domains]

International Conference “Achievements and future steps”
Bucharest, December 10, 2015
Project summary

- **Project Promoter:**
  University of Craiova, Craiova, ROMANIA

- **Project Partners:**
  P1: Politehnica University of Bucharest, ROMANIA,
  P2: SINTEF Technology and Society, Trondheim, NORWAY,
  P3: St. Olavs Hospital, Trondheim, NORWAY

- **Budget:** € 1.101.000  
  **Duration:** 34 months

- **Objective:** enhance the accuracy and guidance, together with the option of a preliminary optical diagnosis on biopsy site, for peripheral lung nodules investigation

- **Target groups/end-users of projects results:** patient with lung pathologies/cancer, research and scientific, students and trainee,
The University of Craiova was founded pursuant to Law 138/25 April 1947 and has been ranked among the 10 Romanian universities in all the national and international classifications in the last 20 years. 12 Colleges (Faculties), and 18,000 students/year, INCESA – a new multidisciplinary research center (> 18 mil. Euro)
Programme RO14 - “Research within Priority Sectors”

Project Partner 1 – “POLITEHNICA” University of Bucharest, ROMANIA

University POLITEHNICA of Bucharest is the largest and the oldest technical university in Romania, with more than 180 years of existence,

University POLITEHNICA of Bucharest has 15 faculties and more than 25000 students

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Project Partner 2: SINTEF. Trondheim, NORWAY

SINTEF is the largest independent research organisation in Scandinavia

- Leading expertise in the natural sciences and technology, environment, health and social science
- 2100 employees from 70 countries
- Customers in more than 60 countries
- A non-commercial research foundation with subsidiaries

SINTEF, Dept. Medical Technology
Ultrasound and image-guided interventions
18 research scientists, half holding a PhD, backgrounds in biophysics, mathematics, computer science, software development, medical technology, cybernetics, electrical engineering, biomechanics
St. Olavs Hospital is the University Hospital for Mid-Norway, and integrated with the Norwegian University of Science and Technology in Trondheim. Patient treatment, research and education are integrated functions. The University Hospital is in the central part of Trondheim. The new hospital was completed in 2015. 1/4 of the area is allocated to university and teaching functions.
Project rationale

- Lung cancer - 28% of all cancer deaths, 1.3 million deaths/year
- To diagnose - CT scan + transbronchial biopsy procedure
- > 50% of peripheral nodules are not accessible by bronchoscopes
- Follow up with invasive methods: CT-guided percutaneous needle biopsy or a surgical biopsy
- **A navigation system (named NAVICAD) based on harmless technologies is necessary for guiding during peripheral lung nodules biopsy**
- A fast, optical analysis at biopsy site will be a plus.
Project rationale

- NAVICAD system is using an electromagnetic technology (AURORA) developed by Northern Digital Inc.
- AURORA computes spatial position and orientation of a sensor placed in medical instruments, relative to an magnetic field generator.
Project outcomes (planned vs. achieved)

- expected outcomes:
  - the prototype of a minimally invasive image-guided system based on electromagnetically tracking, with option for optical biopsy using a probe-based confocal laser endomicroscopy fiber (Cellvizio) and a module of computer-aided diagnosis (CAD) for a fast pCLE image analysis.
  - 7 scientific papers
  - One patent application
Project outcomes (planned vs. achieved)

- NAVICAD structure

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Project outcomes (planned vs. achieved)

- outcomes to date:
  - feasibility study, definition and specification of the NAVICAD system, trial scenarios and methodology - completed
  - design and development of an innovative biopsy forceps with electromagnetic tracking features – completed (patent application ongoing)
Project outcomes (planned vs. achieved)

- outcomes to date:
  - CAD module - completed
    - image reading/processing functions,
    - fractal analysis,
    - grey-level co-occurrence matrix (GLCM),
    - a feature identification module based on the Marching Squares and linear interpolation methods,
    - a neural network to automatically interpret the imaging data and diagnose the pathological
    - preliminary tests, diagnosis accuracy > 85%.
Project outcomes (planned vs. achieved)

- outcomes to date:
  - General Software Specifications and Functionalities
    - Virtual Bronchoscopy - completed
    - Rendering and segmentation of the lungs - completed
    - Virtual navigation through 3D patient image - completed
    - Route planning – under development
    - Real navigation during procedure - completed
    - Electromagnetic (and optical) tracking - completed
    - Tracking corrections – under development
  - Cross-platform (Linux, Windows, Mac OS), based on latest technologies (Qt, VTK, CommonToolkit, CustusX)
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Publications


Publications


Reflections on partnership

- role and contributions to the project of PP/pp,
  - PP: coordinate and develop most of the NAVICAD system modules, testing, dissemination, patenting,
  - P1: software modules development (virtual bronchoscopy), testing
  - P2: system design, some software modules development, testing
  - P3: definition of clinical requirements and specification, clinical proof-of-concept and small scale studies
Reflections on partnership

- strong points and weak points
  - Strong points: dedicated research scientists and long lasting clinical collaborators work together, engineers in the interventional suite in ongoing studies, some national and regional funding existing to back up work and involve Master students and PhDs/PostDocs.
  - Weak points: no additional EU funding yet, expensive technology (EBUS, Cellvizio, ...)

- what could be improved
  - looking for less expensive solutions and additional calls for NAVICAD future developments (new features, extended clinical applications)
Future steps

- looking for funds to extend NAVICAD to a complex medical platform for diagnosis and treatment in oncology: gastroenterology, bronchoscopy, radiation therapy, minimal invasive surgery
Future steps

- sustainability of consortium:
  - we continuously look for H2020 opportunities
  - we will start looking more closely at the ITN call for September 2016 to establish a broader consortium based on NAVICAD and to get international PhDs and more mobility in the field of R&D
  - depending on possible companies to collaborate with, we are considering EuroStars program and the SMB Enterprises
  - new calls from EEA for technology transfer (advancing from TRL6 to TRL9)?
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